MANPRINT Quarterly

Summer/Fall 1998

Director's Corner

Of great significance to the MANPRINT Program is the initiation of staffing actions to form a permanent MANPRINT Board of Directors to be Chaired by very high ranking Army officials. This Board will follow the General Officer Steering Committee that met over the last two years in seeking to institutionalize high level support for the Program.

On another topic, feedback from many attendees of this year's MANPRINT Symposium confirmed our perception that the program presented, the speakers and the quality of their presentations, was a great success. The Symposium was well attended. Therefore, we are planning to meet again next year.

On a personal level, I have decided to retire from civilian service and to work in the private sector. I want to thank all of you for helping me bring new life to the MANPRINT Program. Dr. Bob Holz will serve as Acting Director until LTG Ohle decides on a permanent replacement.

Jack H. Hiller
Director for Personnel Technologies

Contents...

MANPRINT Quarterly

The MANPRINT Quarterly will now be available via our web page *www.manprint.army.mil*. We will no longer mail out paper copies unless you notify us that you prefer to continue or that you do not have access to the internet. Please indicate your preference on the Reader's Response page (page 11).

MANPRINT Directory

We are still updating the "MANPRINT Directory" POC Listing" to include everyone's Email address and fax number. If you need to update your information, please take the time now to fax or Email your changes to:

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simmoms@hqda.army.mil
FAX:(703)697-1283

The U. S. Army MANPRINT Program is online at www.manprint.army.mil.

The purpose of the MANPRINT web site is to increase awareness and application of the MANPRINT program by providing a user friendly source of information about the MANPRINT program.

The goal of the MANPRINT web site is to provide a world wide accessible site that, within 6 - 10 mouse clicks provides an overview of the program, describes specific applications of the program and provides information on how to reach a subject matter expert.

The web site objectives are:

a. Orient the visitor to the program
b. Describe who the players are in the MANPRINT team and how they work to support ICTs, IPTs and Testing
c. Provide immediately accessible information about who to contact for more information about the program or a specific aspect of the program
d. Describe tangible benefits of the MANPRINT program
e. Provide MANPRINT reference material
f. Provide MANPRINT job aids
g. Describe MANPRINT training and provide the course schedule and contact information
h. Provide information about upcoming events
i. Provide a source for releasing MANPRINT news

We welcome your comments and have included a feedback mechanism at the bottom of each page.

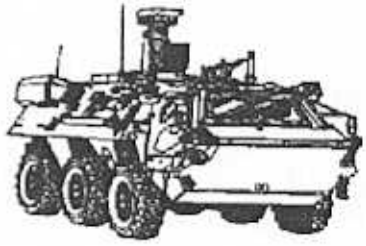
A Quick Response Approach to Assessing the Operational Performance of the XM93A1 NBCRS Through the Use of MANPRINT Modeling Tools[1] and Validation Testing

[How MANPRINT Affects Operational Performance]

Richard W. McMahon,
Human Research and Engineering Directorate
U.S. Army Research Laboratory

This paper describes some of the benefits and analytical requirements of an integrated plan of manpower and personnel integration (MANPRINT) tool modeling and system testing in the context of an operational evaluation of the XM93A1 Nuclear, Biological, Chemical Reconnaissance System (NBCRS) conducted at Aberdeen Proving Ground under significant constraints of time and budget. During extensive Initial Operational Test and Evaluation (IOT&E) at Ft. Bliss, Texas, the NBCRS with three-man crews demonstrated a number of serious performance and safety deficiencies which were attributed mainly to excessive crew workload and inadequacies in work-space design. The Program Manager proposed to make system modifications if some prediction of their utility could be estimated. The NBCRS Test Integration Working Group supported by the U.S. Army Research Laboratory (ARL) proposed a novel operational test methodology that could be executed speedily, within budget, and allowed for a comprehensive operational assessment of the utility of system modifications. The proposed test methodology specified an integrated strategy composed of work-space and task performance modeling to guide equipment redesign and a carefully counterbalanced experimental design that permitted comparison of crew performance on modified and standard NBCRS vehicles during simulated missions. The observed results provided good support for the adequacy of the model-guided redesign of the NBCRS.

XM93A1 Nuclear, Biological and Chemical Reconnaissance System (NBCRS)



Background

The XM93A1 Nuclear, Biological, Chemical Reconnaissance System (NBCRS) is a steel-hulled, diesel-powered, armored, amphibious, wheeled vehicle capable of performing the reconnaissance roles of nuclear, biological and chemical (NBC) detection, warning, communication, and intelligence gathering. The vehicle can be deployed independently or in conjunction with conventional reconnaissance elements. The NBCRS has the capability to detect NBC contamination in the surrounding environment through the use of point and remote detectors. The NBCRS crew (originally four soldiers but reduced to three in the M93A1 NBCRS) combines NBC contamination information with data from other on-board systems (e.g. meteorological sensor and position mapping system) in order to transmit contamination hazard intelligence to the appropriate tactical operations center.

Six XM93A1's will be authorized in each heavy division, motorized division, and armored cavalry regiment chemical company. Each Corps and theater NBC reconnaissance company will be authorized 36 XM93A1

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[1] A Set of ARL (HRED) geometric and task analysis modeling tools used to evaluate the MANPRINT characteristics of a system.

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vehicles. In addition, each NBC reconnaissance team assigned to separate maneuver brigades or theater defense brigades will be authorized one XM93A1.

The XM93A1 completed Pre-production Qualification Testing (PPQT) and Initial Operational Test and Evaluation (IOT&E) in FY94. Testing resulted in an evaluation of "not effective" and "not operationally suitable" largely because of operational issues related to MANPRINT. The testing concluded that a three-man crew could not operate the XM93A1 because vehicle and workstation design was not in accordance with appropriate guidance related to safety and human engineering.

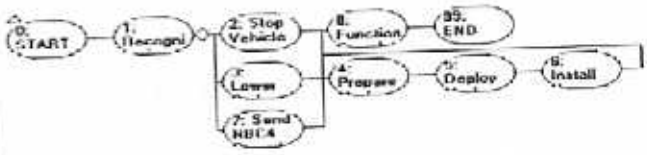
Approach

The Project Manager for NBC Defense Systems, Operational Evaluation Command, Army Materiel Systems Analysis Activity, Chemical School, and the U.S. Army Research Laboratory developed a corrective action plan to address the problems identified during the test phase. ARL supported the program with a two-phased modeling effort aimed at improving vehicle three-man crew suitability and workstation design. The first phase concentrated on using a computer-aided drafting human figure model to identify optimum positions for various hardware components and to determine whether the suite operator could monitor the MM1 detector display and the agent sampling wheels from the rear workstation.

ARL Human Figure Model of XM93A1 NBCRS

The second phase used the ARL hardware vs. manpower (HARDMAN) III model development tool to model the operational mission task sequence and the time required to perform a mission with the current three-man crew version (XM93A1) compared to an XM93A1 with modified workstation. The HARDMAN III modeling tool is a computer-based system (nine distinct modules) for assessing soldier-system performance. For the NBCRS analysis, the manpower system evaluation aid (MANSEVAL) module was used to construct a system mission model. The analyst begins the model construction with a mission-level description and then decomposes the mission into its various functions and task performance elements. These tasks are arranged in the appropriate sequences and tied to the average and fastest performance time. By adding or deleting task elements, "what-if" analyses of the effect of task modifications can be estimated by the model. This is how the effects on performance of particular work-space redesign options in the NBCRS were estimated and a "best" configuration was adopted by the materiel developer. The HARDMAN III modeling estimated that the modified system could perform a route reconnaissance mission with a crew of three and do it 12% faster than the existing system.

ARL HARDMAN III Task Network Model of Route Reconnaissance Mission



The final phase of the corrective action plan consisted of developing an operational MANPRINT validation (OMV) [test] of the modified NBCRS to test the ability of the three-man crew to respond to challenges of the detection suite system (because of environmental restrictions, only calibration gas was used to stimulate the system in place of chemical simulant) while performing simulated route and area reconnaissance missions over a prescribed test course. The essential parameters that drove the test planning were the limited availability of redesigned systems and qualified crews, the compressed time schedule for testing, the need to maximize the performance impact of system modifications while minimizing the number of redesigns, and the need to make a reasonably

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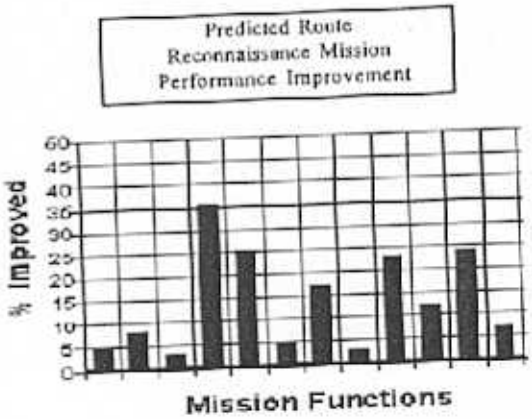
secure assessment of the redesign based on a modest number of trials and data points. The test design attempted to accommodate these considerations by 1) employing a strict counterbalanced comparison that would permit a comparison of each crew's task performance on the redesigned system and the standard IOT&E system, 2) data collection procedures to record task component performance times, and 3) standardized scenarios that would systemize the mission events across crews.

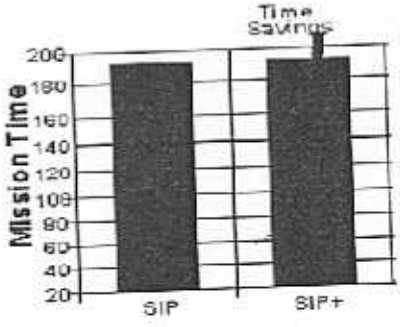
One NBCRS vehicle was configured with the hardware changes/additions recommended by the modeling effort (modified system), which were designed to address suitability (safety and task performance) deficiencies related to operation of the NBCRS by a three-man crew. The other system was configured in the system design that was used during the IOT&E (standard system). Four three-man crews of NBCRS qualified soldiers were trained at Ft. McClellan, AL, and APG on both systems. Nine of the 12 crew members had previously participated as test players in the IOT&E. The test consisted of two NBCRS vehicles running the same 96-hour scenarios each week on the same courses. These crews operated the modified NBCRS and standard NBCRS on a balanced schedule over the 2 weeks, which permitted each crew equivalent missions on both systems. Two crews operated the modified system for alternating 12-hour periods each day, and two crews similarly operated the standard system for alternating 12-hour periods. At the start of the second week of test, the crews switched to the other system type. In order to maintain an approximation of the normal stress level of a 96-hour scenario that specifies 18 hours of mission time each 24 hours, crews were kept awake, performing supervised activities for an additional 6 hours each day following the completion of their 12-hour scenario. Each 12-hour period, crews conducted two route missions, one area mission, and an XM21 chemical standoff excursion as well as normal preventive maintenance checks and services.

Operator task performance times, crew workload ratings and comments were collected to determine the adequacy and suitability of the hardware modifications. Health, safety hazards, and human factors engineering (HFE) deficiencies were examined to determine if additional hardware changes/modifications were required.

Results

The OMV test results demonstrated that the crews' performance times of route and area mission tasks relevant to the redesign on the modified system were significantly faster (using the SAS General Linear Model program) than when performed on the standard system. These results confirmed the HARDMAN III model estimates of improved performance related to the system redesign efforts. Total event times for these tasks were measured to be 10% to 35% faster (variant effect only, with practice effect across weeks subtracted) with the modified system compared with the standard system. The equivalent tasks had nonsignificant differences between system type.





Conclusion and Follow-up

The concept of an integrated evaluation approach using MANPRINT tool models and validation testing described here seems appropriate whenever assessments concern system operational performance. The combination of task and work-space modeling combined with an appropriately controlled test design increases the value of each

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data point by reducing noise. Test budgets are often directly affected by the number of data points needed to make an assessment. In addition, the increased analytical resolution of these designs permits more reliable and documentable post hoc and what-if analyses instead of expensive re-testing.

A Milestone III in-process review for the XM93A1 NBCRS was conducted on 26 June 1995, and the system was type classified standard. The human figure model database will be used during the Block II integration of technological improvements to optimize soldier-system interaction and workstation design. Operational data collected during the OMV test were used by ARL to update and accredit the HARDMAN III model for future use by the Operational Evaluation Command in planned NBCRS program block upgrades. On 26 July 1995, the Commander, Operational Test and Evaluation Command (OPTEC) approved an accreditation plan for the NBCRS modeling effort in support of future operational testing. The plan covers the use of the manpower-based system evaluation aid (MANSEVAL) module of HARDMAN III, Version 5.0, model in future evaluation of the NBCRS. Part IV, section d ("Future Operational Test and Evaluation") of the NBCRS test and evaluation master plan (TEMP) identifies the requirement for "an OPTEC accredited modeling and simulation of critical task execution and workload for those performance activities supporting system-level mission essential functions to support verification and assessment of any impact" [of future changes]. On 15 January 1998, an accreditation statement for the HARDMAN III model of the NBCRS was approved by the Commander OPTEC.

MANPRINT Inclusion in Army Acquisition Source Selection Process

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The Army Acquisition Executive, Mr. Paul J. Hoeper, signed the above subject on August 21, 1998.

References: a. Memorandum, Army Acquisition Executive, October 7, 1997, subject: Manpower and Personnel Integration (MANPRINT) Policy. b. U.S. Army Audit Agency Report, Incorporating MANPRINT into Weapon Systems Development, Report #AA 97-205, June 10, 1997, c. Minutes of Manpower and Personnel Integration (MANPRINT) General Officer Steering Committee (GOSC) Meeting of September 29, 1997.

The purpose of this memorandum is to voice my strong support for the MANPRINT Program and to increase your awareness of the need to make MANPRINT considerations an explicit part of the source selection planning and implementation processes. MANPRINT is a key factor in both total cost of ownership/life cycle cost and integrated soldier machine system performance.

Effective this date, all required and appropriate MANPRINT requirements and opportunities will be evaluated and considered in the best value tradeoff analyses associated with source selection for acquisition of all Army systems. Solicitations shall require offerors to respond to all pertinent MANPRINT considerations in the Statement of Work (SOW), which shall reflect requirements from the Operational Requirements Documents (ORD)/Mission Needs Statement (MNS) (and possibly enhanced through market research and/or IPT contributions). Important MANPRINT issues or opportunities identified in paragraph 4 or 5 of an ORD shall be addressed and evaluated as specific, standalone functional requirements in the SOW.

The referenced memorandum (Ref. a) from the Army Acquisition Executive directs that MANPRINT be considered in all Army acquisition programs. This directive was issued in response to the referenced Army Audit Report (Ref. b) and the findings of the MANPRINT General Officer Steering Committee (Ref. c). The referenced minutes also emphasize MANPRINT compliance considerations

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and opportunities in the source selection process for Army systems.

Program managers have a responsibility to address Human-System integration (MANPRINT in the U.S. Army) as an essential part of the overall system design and acquisition process. These requirements are stated in DoD Regulation 500.2-R; AR 602-2, MANPRINT in the Materiel Acquisition Process; and Army PAM 70-3, Army Acquisition Procedures.

I expect your full cooperation in ensuring that MANPRINT is an integral part of the materiel development and acquisition/source selection processes. Our soldiers expect and deserve the safest and most efficient and user-optimized systems and equipment that we can provide. I expect no less for our primary customers.

MANPRINT and FORCE XXI

Lieutenant Colonel David Dean, MANPRINT Staff Officer, Personnel Technologies Directorate, ODCSPER, assigned to the Force XXI Digital Force Coordination Cell , Fort Hood, Texas

The fielding of the first digital division (FDD) at Ft. Hood presents a target rich environment for monitoring the seven domains of MANPRINT. These are exciting times at Ft. Hood as we work through the challenges of fielding the first digital division in the year 2000 and continue forward to field the Army's first digital corps in 2004. As wonderful as the technology is that will enable the FDD, it has already demonstrated that it will most likely not diminish, but rather increase the Army's need for the quality soldiers that now serve. Manpower, Personnel and Training issues and concerns are becoming more defined as the fielding of equipment and the reorganization under a new MTOE occurs in the Fourth Infantry Division (4ID).

Overcoming the technical challenge and the struggle to meet timelines creates MANPRINT concerns, despite a sincere belief by virtually everyone involved that the finished product should be as soldier friendly as possible. Unfortunately, in more than a few instances, this has not been the result for prototype and new systems. BG Honore, Assistant Division Commander (Supply), First Cavalry Division, recently was critical of the fielding process and the difficulties soldiers are experiencing with their new equipment. This was further highlighted during a recent M1A2 User's Jury I attended. With a smaller force under stiff manpower constraints and with the increased complexity that digitization brings, MANPRINT moves from useful to critical. MANPRINT must be a strong and constant consideration in developing and fielding Force XXI if we are to achieve the operational and lethality goals defined.

With this as a concern, the Army's Director for MANPRINT made the decision to permanently station a member of the PERTEC Staff at Ft. Hood, Texas to ensure MANPRINT involvement in Force XXI. The officer assigned was to be positioned at the Experimental Force Coordination Cell (ECC), now known as the Digital Force Coordination Cell (DFCC). LTC Jerry Payne moved into this assignment in 1996. I replaced him in March 1998 after he was selected to be the Program Manager for Common Hardware/Software at Ft. Monmouth, NJ. I came to the job with virtually no acquisition experience but a strong background in operational units and training soldiers. I have been impressed with the

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FY 99 MANPRINT Training Schedule

MANPRINT ACTION OFFICER COURSE (MAOC)

CLASS	START DATE	END DATE	LOCATION
99-706	02 Feb 99	11 Feb 99	Huntsville (AMCOM), AL
99-001	22 Feb 99	04 Mar 99	Ft Lee, VA
99-702	13 Apr 99	22 Apr 99	Ft Belvoir, VA
99-703	04 May 99	13 May 99	Ft Huachuca, AZ
99-704	13 Jul 99	22 Jul 99	Ft Leonard Wood, MO
99-002	09 Aug 99	19 Aug 99	Ft Lee, VA
99-705	21 Sep 99	30 Sep 99	Ft Gordon, GA

MANPRINT APPLICATIONS COURSE (MAC)

CLASS	START DATE	END DATE	LOCATION
99-702	01 Dec 98	04 Dec 98	Ft Huachuca, AZ
99-703	08 Dec 98	11 Dec 98	Ft Belvoir, VA
99-706	09 Mar 99	12 Mar 99	Ft Eustis, VA
99-707	23 Mar 99	26 Mar 99	Huntsville (AMCOM), AL
99-704	25 May 99	28 May 99	Ft Gordon, GA
99-708	08 Jun 99	11 Jun 99	Natick, MA
99-705	22 Jun 99	25 Jun 99	Rock Island, IL
99-709	03 Aug 99	06 Aug 99	Warren, MI

(POC: Mr. Jan Dykhuis, COM (703) 325-3239, DSN 221-3239)

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scope and complexity of Force XXI and the MANPRINT issues associated with it.

I've discovered as soon as you make it known at Ft. Hood that you're assigned to HQDA, ODCSPER, you'll be deluged with personnel problems (including solicitation to assist in obtaining an assignment to Hawaii). Working with Force XXI, PERSCOM, and DCSPER on the many developing manpower, personnel and training issues is a large part of my job, simply because it presents such an important requirement for the success of Force XXI. If a soldier slot is not filled, or a soldier assigned is unable to meet the skills required in his assignment, or training is not adequate to prepare or sustain the skill required, mission readiness will not be achieved — regardless of how sophisticated and capable the equipment is.

Educating my associates on MANPRINT is an equally important aspect of my assignment. This is an ongoing process because of the rapid turnover of key personnel internal to the DFCC and within Force XXI in general. I am familiar with what the armor soldier deals with in his professional life, and can project how a certain piece of equipment will interface with that soldier deep into a Combat Training Center (CTC) rotation. It is much more difficult to visualize what occurs in Combat Service Support or Field Artillery. Fortunately, there is an existing wealth of expertise in all battlefield operating systems that, enlisted to be watchful for MANPRINT issues, is greatly beneficial for Force XXI. My other duties include but are not limited to:

- Assist in the development of on-site MANPRINT system assessments.

- Work with user personnel and Program Managers to develop potential alternatives to critical system interface issues.

- Represent the MANPRINT Community at System User Juries conducted by the material developer community.

- Represent the DFCC, III Corps and DCSPER by participation in Integrated Product Teams, Joint Working Groups, and Integrated Concept teams as a subject matter expert for MANPRINT or locator for experts in the MANPRINT domains.

- Review system acquisition support documents for MANPRINT issues.

- Observe and analyze human factors interface issues with respect to fielding of Force XXI programs (Fielding Priority 1&2) and make recommendations relative to system-user interface issues, manning structure and personnel readiness impact, system training requirements, and other human factors.

MANPRINT has and will continue to benefit the Force XXI development process. Although somewhat steam rolled at first, I'm enthusiastic about participating in Force XXI. Let me also add that I welcome the opportunity to be of assistance to any MANPRINT Quarterly readers in their MANPRINT or other activities related to Force XXI.

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